

accomplished by the attachment of the u-joint 526 to push-pull resisting bearingly supported intermediate shaft 506, which in turn is coupled to the inner member 58 (FIG. 2) of drill string 20 and inner member drive group 78. Being rotationally uncoupled from enlarging and engaging surface 502, the pipe positioning arm 508 may be held without axial rotation or, as sometimes desired, re-positioned and held in a different rotational orientation by proper control of inner member drive group 78. An uphole or downhole brake (not shown) may augment the holding of a particular orientation, as well as to prevent accidental indexing. An orientation sensor, such as roll-sensing beacon 530 signal-emissively housed on or within pipe positioning arm 508, provides useful information toward this rotational positioning action. Rotational stops (not shown) may beneficially prevent the inner member drive group 74 from applying more than a fractional revolution of bi-directional (i.e., clockwise and counterclockwise) motion to intermediate shaft 506. Allowing more than partial revolution of the shaft 506 could detrimentally affect the routing (not shown) of actuating power and control signals to and from the arm positioners 450 510. The above-described 90°-arrangement of two arm positioners 510 substantially reduces or eliminates the need for partial rotation of shaft 506. Knowing the rotational orientation of shaft 506, the product pipe 14 may be shifted the desired amount of offset away from the center of borehole 42 in the desired radial direction with pipe positioning assembly 500 through geometrically-determined respective causal amounts of extension or retraction of the two arm positioners 510. The rotational orientation of shaft 506 is sensed by beacon 530, while the respective amounts positioners 510 are extended or retracted may be measured by one of several known displacement sensing techniques or by precise metering of power or fluid to each positioner. Alternately, rotational encoders may be employed to sense the dual-plane angular articulation of u-joint 526. By way of the information communicated from these sensors to control system 48 (FIG. 1), the central axis of the leading end of product pipe 14 may be held in approximate concentric alignment with borehole 42 or, when desirable, moved in one of many possible radial directions to positions laterally offset with respect thereto under manual or automated control, as previously indicated. The radial placement position of the line of pull applied to the leading end the product pipe 14

may thus be varied, whenever desired, as the pipe positioning reamer assembly 500 pulls it into newly created segments of borehole 42.